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Defluidization in fluidized bed gasifiers using high-alkali content fuels - DTU Orbit (09/11/2017)

Defluidization in fluidized bed gasifiers using high-alkali content fuels

major concern in thermal conversion of biomass encountered in fluidized beds is bed agglomeration, which may result in de-fluidization, leading to unscheduled downtime and additional costs. Biomass fuels, especially herbaceous plants, often contain significant amounts of silicon, potassium and calcium, which may form viscous melts that adhere on the surface of the colliding bed particles and bind them to form agglomerates. In this paper, studies were made to understand the behavior of inorganic elements (mainly K, Si and Ca) on agglomeration and de-fluidization of alkali rich bed-material samples undernon-oxidizing conditions in a bench-scale fluidized bed reactor set up. The de-fluidization studies involved measurements with sand and pure potassium salts (KCl and K_2CO_3) as well as with bed material samples obtained from a 6 MW Low Temperature Circulating Fluidized Bed (LTCFB) gasifier using strawas a fuel. It was seen that in sand þ KCl agglomerates, the sand particles were bound by KCl melts. Onlyvery limited chemical reaction was observed between KCl and the sand particles and no presence of silicate melts in the agglomerates. For sand þ K_2CO_3 mixtures and for LTCFB bed material samples,agglomeration could be attributed to viscous silicate melts formed from reaction of inorganic alkalineand alkali earth species with silica from the bed particles. A mathematical model that addresses the defluidization behavior of alkali-rich samples was developed based on the experiments performed in the bench-scale fluidized bed reactor as well as on results from literature. The model was then used topredict the de-fluidization behavior of alkali-rich bed material in a large-scale LTCFB gasifier.

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